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LANDSAT SUPPORTS DATA NEEDS

FOR

EPA "208" PLANNING

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"DRAFT"

**LANDSAT SUPPORTS DATA NEEDS
FOR
EPA "208" PLANNING**

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OBJECTIVE OF THE REPORT

Landsat-derived remote sensing data has present and potential utility for meeting national goals for water quality planning. Specifically, EPA "208" area-wide waste treatment management calls for identification and control of activities in large geographic areas requiring data attainable from remote sensing.

Intergovernmental, cooperative effort is necessary to achieve the goals established for areawide water quality planning and management by the Federal Water Pollution Control Act. The federal program officer oversees and assists the states and other non-federal agencies in meeting these goals, which are given clearer definition for action in regulations promulgated by EPA, and EPA "208" agency personnel collect necessary data and develop the plans leading to implementation.

Landsat remote sensing can be one tool in developing plans, guiding implementation and monitoring results. State experiences illuminate this potential for both the Federal Program Officer responsible for overseeing and the non-federal operating agency personnel responsible for planning and implementation.

This report provides both the framework for EPA "208" areawide planning - federal legislation and regulations - and examples of state opportunities and experiences using Landsat. Present activities suggest that this type of remote sensing is an efficient, effective tool for areawide water quality planning. New capabilities are being developed. Interaction with cognizant federal, state and local people involved in 208 activities can guide these developments and enhance their utility and prospect for use.

FEDERAL LEGISLATION

Federal Perspective

Federal legislation speaks to the goals of the Nation. Fulfillment of these goals often requires the cooperative spirit of federalism embodied in specific program mandates for non Federal governments, most often States, to implement with guidance and financial assistance derived from the original legislative mandate. Regulations promulgated by the responsible Federal agency provide the guidance and establish monitoring targets which States can look to in developing programs to help achieve national objectives.

The Federal Water Pollution Control Act (P.L. 92-500) addresses the national goals for restoring and maintaining the integrity of the Nation's water. To achieve these goals several programs are established including areawide water waste treatment management -- EPA '208' planning. The Environmental Protection Agency is the cognizant Executive Agency. States and/or the EPA designate 208 agencies which are the entities responsible for developing and implementing areawide waste treatment plans. The following excerpts are sections from P.L. 92-500 providing the legislative mandate and sections from the U.S. providing Agency guidance for areawide 208 planning.

Federal Water Pollution Control Act (P.L. 92-500)

Sec. 101. (a):

The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In order to achieve this objective it is hereby declared that, consistent with the provisions of this Act -

- (1) it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985;
- (5) it is the national policy that areawide water treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State; and
- (6) it is the national policy that a major research and demonstration effort be made to develop technology necessary to eliminate the discharge of pollutants into the navigable waters of contiguous zone, and the oceans.

- (b) It is the policy of the Congress to recognize, preserve, and protect the primary responsibilities and rights of States to prevent, reduce and eliminate pollution, to plan the development and use (including restoration, preservation, and enhancement) of land and water resources, and to consult with the Administrator in the exercise of his authority under this Act.

Areawide Waste Treatment Management

Sec. 208. (a) For the purpose of encouraging and facilitating the development and implementation of areawide waste treatment management plans-

- (1) The Administrator,...shall by regulation publish guidelines for the identification of those areas which, as a result of urban-industrial concentrations or other factors, have substantial water quality control problems.
- (2) The Governor of each State,...shall identify each area within the State which, as a result of urban-industrial concentrations or other factors, has substantial water quality control problems,... shall designate (A) the boundaries for each such area, and (B) a single representative organization, including elected officials from local governments or their designees, capable of developing effective areawide waste treatment management plans for such area....
- (3) With respect to any area which...is located in two or more States, the Governors of the respective States shall consult and cooperate in carrying out the provisions of paragraph (2), boundaries of the interstate area having common water quality control problems and for which areawide waste treatment management plans would be most effective, and toward designating...a single representative organization capable of developing effective areawide waste treatment management plans for such area.

(b)(1)(A) Not later than one year after the date of designation of any organization under subsection (a) of this section such organization shall have in operation a continuing areawide waste treatment management planning process consistent with section 201 of this Act. Plans prepared in accordance with this process shall contain alternatives for waste treatment management, and be applicable to all wastes generated within the area involved.

- (2) Any plan prepared under such process shall include, but not be limited to-
 - (A) the identification of treatment works necessary to meet the anticipated municipal and industrial waste treatment needs of the area over a twenty-year period., annually updated (including an analysis of alternative waste treatment systems), including any requirements for the acquisition of land for treatment purposes; the necessary waste water collection and urban storm water runoff systems and a program to provide the necessary financial arrangements for the development of such treatment works, and an identification of open space and recreation opportunities that can be expected to result from improved water quality, including consideration of potential use of lands associated with treatment works and increased access to water-based recreation:

- (C) the establishment of a regulatory program to -
(i) implement the waste treatment management requirements of section 201(c).
(ii) regulate the location, modification, and construction of any facilities within such area which may result in any discharge in such area, and.
(iii) assure that any industrial or commercial waste discharged into any treatment works in such area meet applicable treatment requirements,...

(E) the identification of the measures necessary to carry out the plan ...

(F) a process to (i) identify, if appropriate, agriculturally and silviculturally related nonpoint sources of pollution, including return flows from irrigated agriculture, and their cumulative effects, runoff from manure disposal areas, and from land used for livestock and crop production, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(G) a process to (i) identify, if appropriate, mine-related sources of pollution including new, current, and abandoned surface and underground mine runoff, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(H) a process to (i) identify construction activity related sources of pollution, and (ii) set forth procedures and methods (including land use requirements) to control to the extent feasible such sources;

(I) a process to (i) identify, if appropriate, salt water intrusion into rivers, lakes, and estuaries resulting from reduction of fresh water flow from any cause, including irrigation, obstruction, ground water extraction, and diversion, and (ii) set forth procedures and methods to control such intrusion to the extent feasible where such procedures and methods are otherwise a part of the waste treatment management plan;

(J) a process to control the disposition of all residual waste generated in such area which could affect water quality; and

(K) a process to control the disposal of pollutants on land or in subsurface excavations within such area to protect ground and surface water quality.

(3) Areawide waste treatment management plans shall be certified annually by the Governor or his designee (or the Governors or their designees, where more than one State is involved) as being consistent with applicable basin plans and such areawide waste treatment management plans shall be submitted to the Administrator for his approval.

(B) Any program submitted under subparagraph (A) of this paragraph which, in whole or in part, is to control the discharge or other placement of dredged or fill material into the navigable waters shall include the following:

(i) A consultation process which includes the State agency with primary jurisdiction over fish and wildlife resources.

(ii) A process to identify and manage the discharge or other placement of dredged or fill material which adversely affects navigable waters, which shall complement and be coordinated with a State program under section 404 conducted pursuant to this Act.

(v) A process to assure continued coordination with Federal and Federal-State voter-related planning and reviewing processes, including the National Wetlands Inventory.

(c)(1) The Governor of each State, in consultation with the planning agency designated under subsection (a) of this section, at the time a plan is submitted to the Administrator, shall designate one or more waste treatment management agencies (which may be an existing or newly created local, regional or State agency or potential subdivision) for each area designated under subsection (a) of this section and submit such designations to the Administrator.

(2) The Administrator shall accept any such designation, unless...he finds that the designated management agency (or agencies) does not have adequate authority-

(A) to carry out appropriate portions of an areawide waste treatment management plan developed under subsection (b) of this section;

(D) to accept and utilize grants, or other funds from any source, for waste treatment management purposes:

(2) For the two-year period beginning on the date the first grant is made under paragraph (1) of this subsection to an agency, if such first grant is made before October 1, 1977, the amount of each such grant to such agency shall be 100 per centum of the costs of developing and operating a continuing areawide waste treatment management planning process under subsection (b) of this section, and thereafter the amount granted to such agency shall not exceed 75 per centum of such costs in each succeeding one-year period. In the case of any other grant made to an agency under such paragraph (1) of this subsection, the amount of such grant shall not exceed 75 per centum of the costs of developing and operating a continuing areawide waste treatment management planning process in any year.

(g) The Administrator is authorized, upon request of the Governor of the designated planning agency, and without reimbursement, to consult with, and provide technical assistance to, any agency designated under subsection (a) of this section in the development of areawide waste treatment management plans under subsection (b) of this section.

(i)(1) The Secretary of the Interior, acting through the Director of the United States Fish and Wildlife Service, shall, upon request of the Governor of a State, and without reimbursement, provide technical assistance to such State in developing a statewide program for submission to the Administrator under subsection (b)(4)(B) of this section and in implementing such program after its approval.

Regulations for Grants for Water Quality Planning, Management and Implementation

Scope and content

On Wednesday, May 23, 1979, amended regulations for EPA 208 planning were issued. Introductory comments to the regulations provide the EPA perspective on the interlocking nature of the federal requirements for an annual State Water Quality Management Plan, the areawide water quality plan EPA 208, and local priorities for waste treatment facilities. This is the context within which the 208 Agency must act to develop the areawide waste management program mandated in PL. 92-500.

Excerpts from the introductory materials are followed by sections of Title 40 of the Code of Federal Regulations as amended. The sections noted below are the regulations the 208 Agency must adhere to in developing the areawide waste management which can be facilitated by use of Landsat remote sensing.

We feel that the requirements in these regulations represent a reasonable balancing of these conflicting institutional interests. States are given a strong management role and a substantial role in developing areawide work programs and setting areawide priorities. New procedures have been added for cooperation and coordination between States and areawides during work program development. However, as intended in the Act, areawide agencies continue to have a direct relationship with EPA. EPA approves areawide work programs, considering State comments, and funds areawide agencies directly Specific comments concerning the State/areawide relationship and our responses are discussed below.

The regulations require that the Governor assure adequate WQM planning consistent with these regulations is conducted throughout the State including in designated planning areas

. . . EPA will consider the State's comments to be a crucial element in EPA's review of areawide work programs and will not approve areawide work programs that are inconsistent with the State's policy framework established in the State work program

. . . State/EPA Agreements must be consistent with approved areawide and State WQM plans and the State strategy, all of which may include local priorities The State must involve areawide agencies in developing the State/EPA Agreement and consider areawide priorities when developing the Agreement. . . .

. . . Direct funding of areawide planning agencies by EPA is established policy. This policy was established because direct funding is necessary to preserve the integrity of the areawide approach to solving water quality problems established by the Clean Water Act.

Excerpts from Title 40 of the U.S. Code of Federal Regulations

Chapter 35 as amended

Section 35.1511 Assessments and State strategy.

Section 35.1511-1 Water quality assessment.

(a) General. WQM agencies shall conduct appropriate assessment activities in accordance with this section to produce information on (1) existing water quality conditions, and (2) the impact on water quality of future events, such as population changes, changes in land use, and changes in economic conditions. Both point and nonpoint pollution problems (including water conservation needs related to water quality) must be assessed While the areawide work program is a separate submission, it must be closely coordinated with State efforts in accordance with the procedures in this subpart. . . .

Section 35.1519-3 Delegation of planning activities:

Designated State and areawide agencies may delegate (through inter-agency agreements) specific planning activities, but not ultimate responsibilities for planning, to other State, Federal, regional, local, and interstate agencies for the conduct of work under this subpart. Delegation shall take place through a written agreement executed by the two agencies, subject to the approval of the Regional Administrator, specifying outputs, time schedules, funding, and how the agencies will coordinate. If a State or areawide agency intends to delegate any major planning activities under this paragraph, locally elected officials of governments having jurisdiction in the affected area shall be consulted prior to execution of the agreement.

Section 35.1521 Water quality management planning

Section 35.1521-1 General.

WQM planning shall be conducted as an activity under the work program by States under sections 208 and 303(e) of the Act and by areawide agencies under section 208 of the Act. WQM plans will address problems identified in the assessment and strategy development process under section 35.1511. WQM plans

(e) Open space and recreational opportunities. The plan shall contain an analysis of open space and outdoor recreational public benefits expected to be achieved under the plan. The plan shall consider recreational use of lands associated with treatment works and increased access to water based recreation. The plan must identify measures which have been and will be taken to enhance open space and recreational opportunities through coordination with facilities planning and State and local recreational programs

(f) Urban impacts. To assure consistency with the President's urban policy and the EPA Urban initiative, as implemented in appropriate portions of Appendix A, subpart E, the plan shall assess the impact of plan provisions on urban development and contain measures for mitigation of adverse impacts. . . .

Section 35.1521-4 Program areas.

Section 208(b) of the Act sets forth planning requirements. This section calls particular attention to aspects of certain program areas the planning must address. The following point and nonpoint program areas shall be addressed in the plan development and revision process

(c) Nonpoint source control. (1) The plan shall describe the regulatory and non-regulatory activities and Best Management Practices (BMPs) which the agency has selected as the means to meet its nonpoint source control needs. BMPs to achieve water quality goals for surface and ground water quality and source control problems shall be identified for the nonpoint sources in section 208(b)(2)(F)-(K) of the Act and other nonpoint sources found to be a problem. BMPs are those methods, measures, or practices to prevent or reduce water pollution and include but are not limited to structural and nonstructural controls, and operation and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters. Economic [sic], institutional, and technical factors shall be considered in developing BMPs. BMPs shall be developed in a continuing process of identifying control needs and evaluating and modifying the BMPs as necessary to achieve water quality goals

THE LANDSAT EXPERIENCE

History of Landsat

Landsat 1 - was launched by the National Aeronautics and Space Administration (NASA) in July 1972. This satellite, and the next two--Landsats 2 and 3--were launched in January 1975 and March 1978 respectively. All three Landsats are remote sensing experimental satellites--that is, the instrumentation, the ground delivery system, and the potential applications for this new type of remote sensing data had never been available before,

It became obvious after a few years of research with these data, that there should be many useful applications in environmental programs in all levels of government. Almost from the first days of the Landsat program, NASA encouraged applications in various discipline areas--including water quality planning--to demonstrate the utility of these data to a wide variety of users. But it was not until the advent of a defined technology transfer effort at NASA that State government was clearly a candidate for technical assistance. Most of the five states, whose experiences are summarized in the following case studies, are graduates of these NASA technology transfer related efforts through industry and universities.

Involving operational government users in using products from experimental satellites created some difficulties as well as some hoped for benefits. Those state users who were able to become familiar with Landsat data found that it provided several unique advantages. When applied to appropriate tasks, use of Landsat showed very favorable cost and time comparisons relative to the use of aerial photography and other data sources. Other advantages included the repetitive collection of Landsat data, the large area covered in a single scene, and the availability of data in computer compatible tapes.

Deterrents to the use of Landsat data initially involved the fact that the data was much different from familiar sources in data format, scale, and resolution. Cloud cover also must be recognized as a limitation with satellite data-collection, reducing the number of scenes available. Some of these limitations are inherent in the capabilities of the Satellite "flown" instruments--such as resolution and cloud cover--and must be taken into account when the data is used.

Some of the limitations to Landsat use, however, are more related to demands placed on the experimental system by the growing number of operational users. Symptomatic of these problems has been the long delivery time between data-collection and delivery of a Landsat product to the user. Waiting two to four months for images or computer tapes may be acceptable for a research activity, but can only dampen the enthusiasm among operational users who would need the data much sooner. "Real-time" uses of Landsat are not yet practical, although improvements can be made and are being planned.

States surveyed about the use of Landsat in support of "208" water quality planning efforts had learned to accommodate the inherent limitations of the data and are planning to expand their use of Landsat. In these states, available Landsat data was used to inventory land use/land cover information. Most existing and anticipated uses were in support of non-point source studies. The information format most commonly used was tabular compilations showing the acreage and/or percentage of each land cover type within watersheds of river basins. Map displays were generated but not used extensively in some states, although a map presentation was the primary product in the one state where Landsat was analyzed with manual interpretation.

It is an interesting observation that most of the following survey states are graduates of NASA technology transfer efforts and related efforts through industry and universities. State capabilities include some form of computer processing of Landsat and a small staff to generate the products. Outreach is also an integral part of these state capabilities, and in many of the survey states, 208 planning requirements provided one of the first operational applications.

South Dakota

Summary of State Program

Two areas of state, Planning and Development Districts II and VI,¹ were designated by the Governor as water quality management areas. The South Dakota Department of Water and Natural Resources² coordinates the 208 Program and administers the planning funds for the non-designated areas of the state.

The South Dakota 208 program has adopted a uniquely successful strategy of concentrating on a few small watersheds each funding year. During the first phase, ten watersheds were chosen to be Water Quality Study Areas (WQSA) by the substate planning and development districts (figure 1). These ten WQSA's were selected as representative of non-point water quality problems in each district that would act as models for dealing with the remaining areas of the state. The initial planning activities in the ten WQSA's included: (1) identification of problem sources and their effect on the particular body of water into which each watershed drained; (2) identification of the Best Management Practices (BMP); and (3) selection of management agencies which would be capable of implementing the BMP's. Local agencies will use other state and federal programs for implementing the BMP's. Several WQSA's, for example, are eligible for Rural Clean Water Program funds. And in some WQSA's the BMP's will be implemented as part of existing SCS and ASCS programs.

Rationale for Using Landsat

Of the nine major³ causes of non-point source (NPS) pollution to streams identified by EPA in 1977,³ agricultural runoff is the most dominant in South Dakota. Most of the state is in cropland or range, and the climate is normally dry, often broken only by torrential rains associated with thunderstorms. This combination makes the landscape especially susceptible to soil erosion. Of prime importance to the South Dakota 208 program is the location of Critical Erosion Areas. Once identified, conservation practices can be applied to these sites to reduce soil loss.

1 These planning and development districts designated to receive 208 funds are also known as: Southeast Council of Local Governments (District II near Sioux Falls, South Dakota) and the Sixth District Council of Local Governments (District VI in the Black Hills area).

2 The EPA 208 Program was formerly coordinated by the Department of Environmental Protection, which was included in the Department of Water and Natural Resources following a reorganization in July 1979.

3 The nine non-point sources are: agricultural runoff, silvicultural runoff, urban runoff, construction activities, mining activities, salt-water intrusion, on-site disposal systems (septic tanks), hydrologic modifications, and surface and subsurface waste disposal.

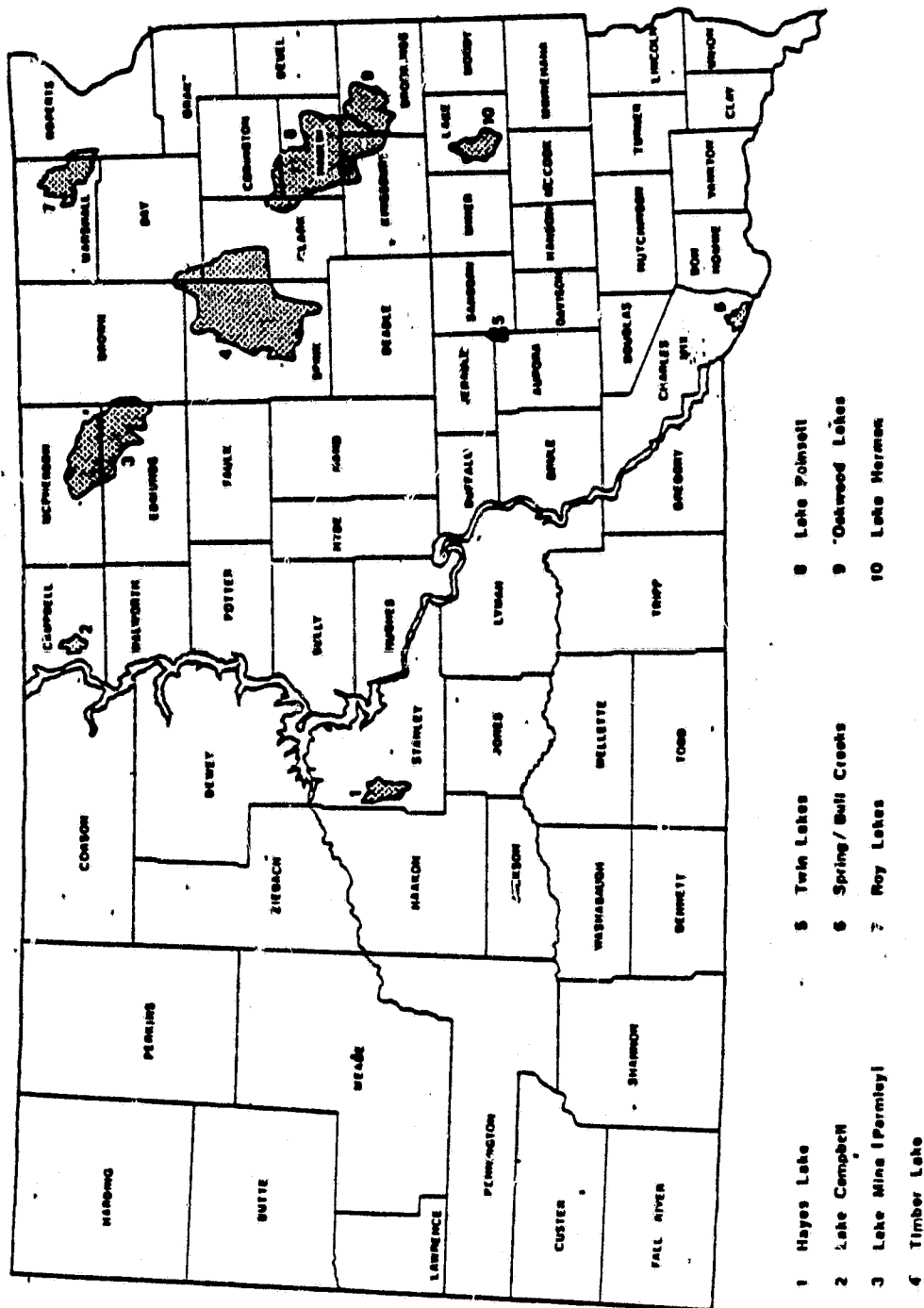


Figure 1. 208 Areawide Water Quality Study Sites

Having current and quantitative land cover information was one of the most important requirements in locating areas of critical erosion in the WQSA's. The land cover classification scheme currently being used for a statewide inventory of land cover by county appeared to provide sufficient detail for use in the WQSA analysis. This classification was adapted from the U.S.G.S. system published in 1976. The following land cover categories were mapped for 208:

Water

Bare soil - includes summer fallow

Small grains - includes broadcast or drill planted crops such as wheat, rye, oats, barley, flax and alfalfa

Large grains - includes row crops such as corn, soybeans, sunflowers, and millet

Pasture or rangeland.

Not every category was present in each watershed studied.

Landsat was a convenient data source for this information because: (1) relatively low-cost, repetitive coverage was available for much of the state within five years of the study; (2) the State Planning Bureau had already developed the Land Resources Information System (LRIS) specifically to analyze Landsat data and use it as part of a computerized geographic information system or data base; and (3) this data base capability - the LRIS - was desired for compositing land cover with soils with slope data to assist the development of Best Management Strategies.

Landsat was only one level of data used. The State Planning Bureau staff used Landsat along with high- and low-altitude aerial photos in eight of the ten WQSA's. In two small watersheds, photography alone was used to generate land cover maps. All land cover maps were verified with ground truth.

Landsat Applications

Landsat data was used to provide land cover maps and statistics (acreage and percentage of each land cover type) for eight of the ten WQSA's.

For three of the study areas (Lake Herman, Hayes Lake and Oakwood Lakes), land cover information was composited with soils and slope information to produce (1) maps showing the location of erosion areas, and (2) statistics for the Universal Soil Loss Equation (USLA) as illustrated in figure 2. These maps and statistics were part of the information used in the 208 planning process to develop implementation strategies.

It is important to be aware that selection of appropriate management practices involves the local Conservations Districts and affected landowners, and that inter-agency cooperation and public participation are very important parts of the 208 process. Consequently, Landsat was not necessarily a visible data source to most participants.

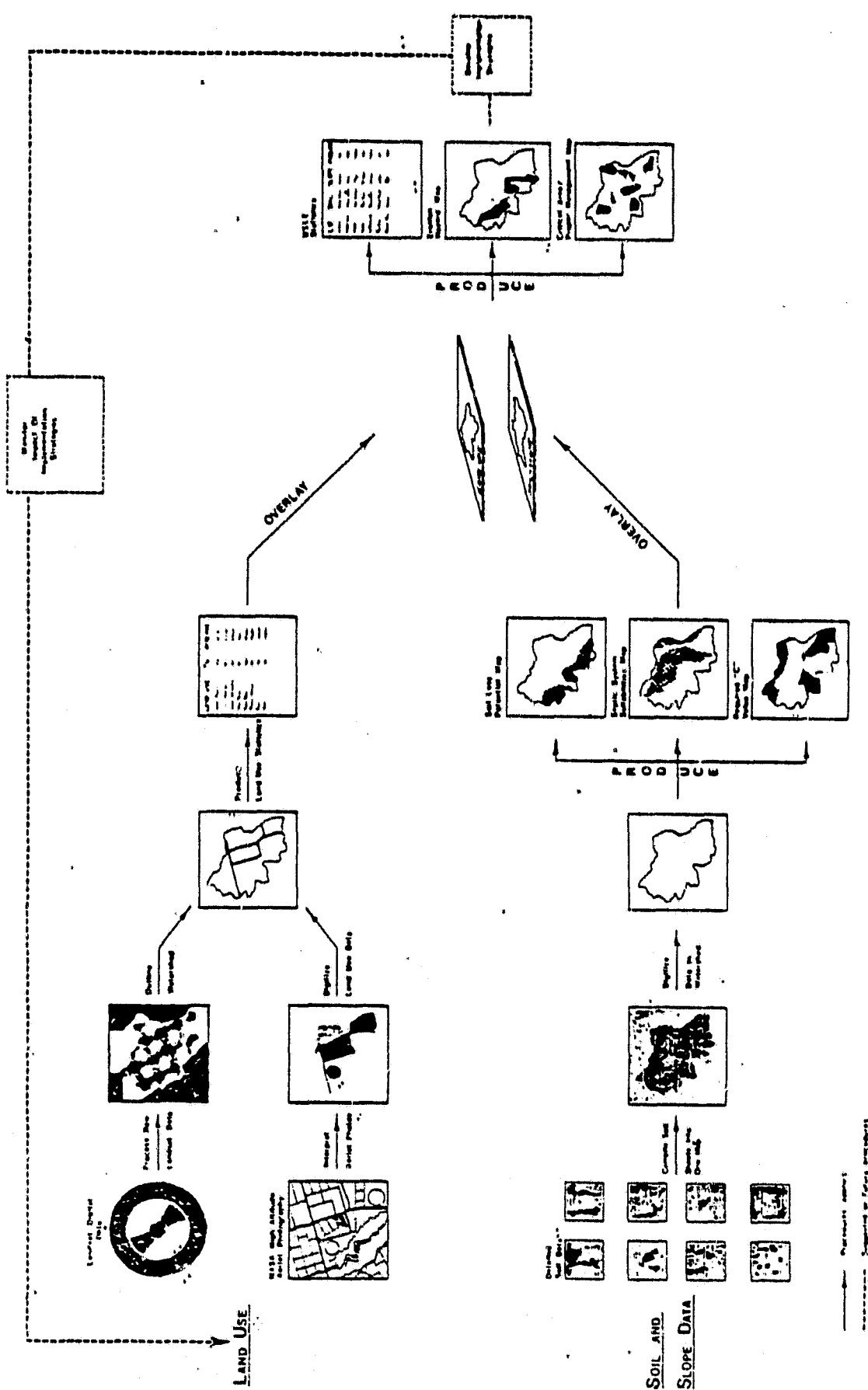


Figure 2. 208 NON-POINT SOURCE POLLUTION ASSESSMENT PROCESS
STATE PLANNING BUREAU

Land cover maps and several derivative maps produced by LRIS were included in documentation submitted to EPA and provided to participants at public meetings. Landsat was credited as the data source on these maps. Confidence in these maps and statistics resulted from overall accuracies of 85% or better and the small number of general categories displayed.

No attempt was made to represent these maps and statistics as the only input to selecting and implementing management practices. Instead, they were used to assist reaching concurrence within a watershed on Best Management Practices (BMP's) and to focus attention on these areas in the watershed that needed the most effort. Ultimately it was left to the individual landowners with the assistance of the local Conservation Districts to implement the appropriate BMP's.

Much of the credit for Landsat use in the 208 program in South Dakota goes to the existing capability within the State Planning Bureau. The LRIS was originally developed in-house by adapting LARS software with the assistance of the EROS Data Center at Sioux Falls, and availability of computer facilities at the University of South Dakota, where the Landsat data is processed. In turn, the LRIS is performing the role of technology transfer agent to other state agencies and programs.

There is no doubt that the use of Landsat has satisfactorily supported and will continue to support 208 planning efforts in South Dakota. And use of Landsat was cost-effective. The first year LRIS effort for the ten watershed was funded by 208 at only \$20,000. The second year of LRIS support for six watersheds will only be about \$15,000. Generally costs per square mile were found to be low - about \$1.72/square mile - for generating land cover maps and statistics and determining accuracies.

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Kentucky

Summary of State Program

State water quality laws are general in Kentucky and oriented toward setting water quality performance standards for river segments. Point source pollution control is emphasized, but planning and control for non-point source pollution is not precluded.

Kentucky water quality planning efforts were initiated in 1974-75 as part of developing River Basin Plans for Section 303 of the federal act. Out of these early planning efforts, the state identified the usefulness of developing an automated geographic information system (AGIS) to handle the variety of data and modeling needs for water quality planning. ADAPT, a digital terrain model-based geographic information system developed by W. E. Gates and Associates, Inc., was chosen for this purpose.

Information needs identified in 303 planning process included: (1) monitoring changing population patterns and (2) distribution of non-point sources of pollution loading on streams and impacts of this type of pollution. These information needs require a systematic analysis of different types of data, and are considered especially suitable for AGIS development and Landsat support.

The early 208 methodology for data collection and analysis relied on staff capabilities in the 121 local conservation districts in Kentucky. However, the recent combination of 303 and 208 programs at the state level will expand the use of the AGIS capability to 208 areawide planning efforts. In addition, it is anticipated that Landsat will become a more regular data source for non-point source studies due to efforts under (1) to integrate classified Landsat data with ADAPT, and (2) to establish an "in-house," Landsat analytical capability for supporting surface mining applications within the Kentucky Department of Natural Resources and Environmental Protection, of which the 208 program is a part.

The Rationale for Using Landsat

Through water quality planning activities in Kentucky, the benefits of having relatively low-cost, repetitive coverage for obtaining current land cover of river basins is viewed as an incentive for using Landsat. In addition, there is an existing state investment in an AGIS especially suited for water quality planning - the ADAPT system. This capability recognizes and uses (1) "non-volatile" information, such as slope, stream location, river basin boundaries, soils and population district (e.g., census tract) boundaries, and (2) "volatile" information such as land use/land cover, and population distributions within population districts. The Kentucky Division of Water Quality looks to Landsat to be one data source for obtaining current land use/land cover. This information would be useful to assist watershed modeling for redeveloping segment priorities, for estimating the impact of changing patterns in population and land cover.

Landsat Applications

Prior to May 1978, Landsat was used in support of 208 planning activities in Kentucky by two substate regional planning councils (the Kentuckiana Regional Planning and Development Agency for nine counties near Louisville, and the Ohio-Kentucky-Indiana Council of Governments for nine counties near Cincinnati) and the Corps of Engineers, Louisville District, for a six-county area near Lexington. All three contracted with Bendix to generate from Landsat computer-assisted land use/land cover classification maps in color, although the display formats, scales and tabulations varied. The Kentuckiana Planning and Development Agency requested land use information to conform to USGS 7½ minute quadrangle maps at 1:24,000 scale with computer tabulations of acreage for each land use within the map boundary. The Ohio-Kentucky-Indiana Council of Governments requested land use at 1:62,500 scale and computer tabulations for each of 229 drainage basins near Cincinnati. The Louisville District, COE, requested land use maps and overlays at 1:48,000 scale for each of the six counties near Lexington, and false-color Landsat images at 1:250,000 scale.

Currently the Kentucky Division of Water Quality has a demonstration contract for \$15,000 under way with ERIM to provide Landsat-derived land use/land cover classification of the entire Kentucky River Basin geometrically corrected and re-formatted to be compatible with ADAPT.

Although the capability to use this information for water quality modeling is in place through the ADAPT system, the state has hesitated to use Landsat regularly because a convenient supplier of Landsat classified data is lacking. The contract with ERIM in Michigan represents one option available through private enterprise. Another option, which is even more attractive at the present time, is a concurrent AGIS development effort to support surface mining activities within the Department of Natural Resources and Environmental Protection that will include a Landsat image-analysis capability.

The prognosis on continuing use of Landsat appears very good, especially since the state is developing a convenient in-house capability to analyze Landsat digital tapes.

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¹ Information compiled from a letter with attachments sent to Mr. Leonard Slosky by Mr. Walter Groszyk, Deputy Director of the EPA Water Planning Division, in May 1978.

Georgia

Summary of State Program

Georgia is one of the few states with a consolidated environmental management program and delegated authority from the U. S. Environmental Protection Agency (EPA) to review, approve and administer permits required by federal laws. During a period when many governmental agencies have increased their paperwork and review requirements, Georgia has effectively minimized the procedures to issue environmental permits. The approach in Georgia assures adequate regulation for environmental protection while greatly reducing the time required for an industry or local government to obtain permits.

The Georgia Water Quality Management Program in the Environmental Protection Division of the Department of Natural Resources has developed a continuing planning process and an annual planning program that combines state and federal objectives, priorities and funding for water quality. The Georgia program has three elements compatible with the federal law: statewide planning, areawide planning and facilities planning.

Statewide water planning relies upon hydrological boundaries for performing evaluations. Since the primary purpose of the basin plans is to establish controls for discharges, allowable wasteloads for pollutants attributable to both point and non-point sources are first determined. Receiving stream water quality standards provide the control criteria for all allocations.

Expanding activities into the assessment and control of non-point source pollution has been initiated in the second phase of statewide planning. Task forces were formed for each non-point source category as a means of effectively addressing the complex demands of each. User agencies involved in each area were requested to participate in the assessment and subsequent delineation of best management practices deemed necessary to control non-point source pollutants. This effort resulted in preparation of a separate Non-point Source Control Program Document.

The four designated areawide planning areas in Georgia are the Atlanta, Chattanooga, Macon and Savannah metropolitan areas. As was the case in the statewide program, point and non-point source pollutant impacts were evaluated, although the non-point source element was grouped into urban runoff and rural runoff categories. Best management practices designed to respond to site-specific urban and rural runoff conditions were developed for each areawide study.

Communities are required to develop detailed facilities plans in order to be eligible for construction funding assistance. These plans address the point source pollution abatement needs of a local study area and must be coordinated with basin plans.

In addition, each planning element relied upon inventories and projections coordinated through the Environmental Protection Division. With the exception of inventories required under present permit programs, existing data had to be assembled and compiled from many sources. Since basin planning concentrated on point source control needs, inventory data were readily available from the permit and grants programs. In the case of non-point sources, the areawide planning agencies and the task forces had to compile inventories from other sources, such as the Landsat-derived land use/land cover statistics generated by the Georgia Resource Assessment Program of the Department of Natural Resources.

Rationale for Using Landsat

In Georgia, as in most states, one of the most probable ongoing uses for Landsat is for current land use/land cover information in support of non-point source pollution control. Georgia is a large and diverse state, in which many non-point source activities occur that contribute to stream pollution. One of the most significant is agriculture. Approximately 13.9 million acres (37%) of the state's 37.2 million acres are in agricultural usage, including 5 million acres classified as "prime farmland." Another significant contributor of non-point source pollution in terms of relative land cover is forestry. Georgia's commercial forest acreage exceeds about 23 million acres, of which only about 2% or less is harvested annually or is undergoing some other type of site disturbance. Other land use/land cover activities contributing to non-point source pollution in Georgia that could be monitored with the assistance of Landsat are: a salt-water intrusion in coastal areas, some hydrologic modification projects such as water quality in reservoirs, and some large mining activities.

When the requirement for statewide and areawide planning was initiated, the Georgia Department of Natural Resources had already developed the capability to analyze Landsat digital tapes with the assistance of the Georgia Institute of Technology, and thus found Landsat to be a cost-effective and convenient data source to assist the inventories for these planning efforts.

Landsat Applications

Landsat was used in the first phase of 208 planning efforts to develop land use/land cover statistics for the 198 Water Quality Management Units and 15 River Basins in Georgia (figure 1). The computer-compatible Landsat data allows the computation of the acreage of various land cover conditions within a watershed (WQMU) that may be related to land-disturbing activities that have a potential for non-point source pollution. From these statistics and supplemental information, EPD developed a comparative ranking of the water sheds based on their potential for non-point source pollution. Best management practices could also be recommended for each watershed.

WQMU #0508'

1	HARDWOOD FOREST (UPL)	47558.0	ACRES	19.530	PERCENT
2	HARDWOOD FOREST (LOWL)	11630.4	ACRES	4.780	PERCENT
3	MIXED FOREST	22493.5	ACRES	9.240	PERCENT
4	SOFTWOOD FOREST	13806.6	ACRES	5.670	PERCENT
5	FOREST MONOCULTURE	6077.1	ACRES	2.500	PERCENT
6	PASTURE/NATIVE GRASS	64519.3	ACRES	26.530	PERCENT
7	CROP (BARE EARTH)	56037.0	ACRES	23.020	PERCENT
8	H.D. URBAN (IMPERV)	4524.7	ACRES	1.870	PERCENT
9	L.D. URBAN (IMPERV)	8355.6	ACRES	3.430	PERCENT
10	EXPOSED EARTH	8123.2	ACRES	3.340	PERCENT
11	WATER	222.4	ACRES	0.090	PERCENT
TOTAL		243347.7	ACRES		

Figure 1. Example of Georgia Statewide Landsat Classification Statistics by Water Quality Management Units.

EPD is also interested in using Landsat data in its solid waste management program, specifically for locating potential sites for solid waste disposal. Some of the conditions that the Landsat can detect, such as distance from surface water, extent of wetlands, and presence of land development, are criteria for solid waste disposal decisions.

In a related application for its Conservation Needs Inventory, the Soil Conservation Service will determine areas of change and extent of change in certain agricultural areas with the assistance of Landsat data. Specific land cover conditions such as pasture, crops and bare ground can be inventoried by satellite. This data can then be aggregated by watershed or by county to give SCS an overview of land cover conditions at the time of the satellite passover.

Products generated by DNR include:

- o Statistics on land cover for each of the 198 Water Quality Management Units (WQMU) in the state. A minimum mapping unit of 1.1 acre was used. For each land cover class that was chosen, the number of acres of land within that class and the percent of the total area of the WQMU that the acreage represented were given.
- o Maps of land cover data at scales of 1:48,000 and 1:63,360 (1 inch = 1 mile) for certain counties, including both separate maps of each land cover type and composite maps depicting total land cover.
- o Statistics on land cover aggregated by county for every county (159) in the state. The 1.1 acre mapping unit will be the basis for this information.
- o Maps covering the entire state, at a scale of 1:250,000, showing land cover at a minimum mapping unit of 1.1 acre.

The history of Georgia's involvement with Landsat goes back several years, before initiation of 208 planning efforts in late 1977. In 1975, DNR became the lead agency in a "technology transfer" project with the National Aeronautics and Space Administration (NASA) to analyze the use of Landsat digital data in Georgia. This project had two objectives:

Phase 1: To determine the feasibility of using satellite-derived information for management applications in Georgia. This phase was successfully completed in the summer of 1976. Two regions or "scenes" of the state - the coastal region and the highlands region - were selected as test areas. Landsat scenes (each 100 mi x 100 mi) were processed to derive land cover information for the following categories: (1) deciduous forest; (2) coniferous forest; (3) wetlands, including salt-water, brackish and fresh-water types; (4) pasture and other grasses; (5) cultivated lands; (6) bare ground; (7) high-density urban; (8) low-density urban; and (9) water. These processed scenes were then printed as color image.

Phase II: To establish an operational capability in Georgia to process the satellite data and produce the products required for several selected management applications. DNR, with assistance from the Georgia Institute of Technology, coordinated a statewide processing effort with the cooperation of several state, federal and regional agencies, that included providing support to the 208 program.

As part of the continuing improvement in the capability of the Georgia Resource Assessment Program of the DNR, land use/land cover information derived from Landsat data is being combined in an automatic geographic information system (AGIS) with other data such as soils, topography and geology to support planning efforts such as 208 non-point source activities. Although not visible in 208 documentation, use of Landsat provided necessary land cover statistics for Phase I, and will likely be expanded for use in special purpose watershed studies when combined with other data.

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New Jersey

Summary of State Programs

Unlike the less populated western states that focused on non-urban land use/land cover information for 208 non-point studies, New Jersey chose to apply Landsat to non-point studies involving mixed urban and rural municipalities within non-designated areas (figure 1). The concept of using Test Municipalities (figure 2) for the initial Landsat mapping was developed for several reasons: (1) to train the computer for discriminating common land cover types using Landsat data tapes for several physiographic provinces of the state, and (2) to develop reliable coefficients from a localized study (municipality) and use them for mapping a larger geographic area (county and watershed), and (3) to demonstrate the suitability of using Landsat data for conducting regional land cover inventories in order to facilitate water quality management planning in New Jersey.

Rationale for Using Landsat

The New Jersey Department of Community Affairs had chosen to develop a system for using Landsat because there was an increasing demand for up-to-date land use information displayed on a large scale. Landsat provided several new dimensions for producing maps and computing statistics from the resultant information. The digital form of the raw satellite data lends itself to various types of statistical analysis, and the 1.1 acre resolution of each pixel (picture element) allows for detailed delineation and editing of land-based information. The regular periodic coverage by the two satellites (every nine days) provides a uniform, quantitative data base that can be updated at relatively low cost. For New Jersey, the cost of statewide orthophotoquad coverage at 1:24,000 scale is estimated to be \$270,000. In contrast, the acquisition, preprocessing, re-formatting, and geometric correction of Landsat data tapes for the entire state cost several orders of magnitude less. Also, most of the cartographic and interpretive work has been automated. The savings of using satellite data instead of conventional aerial photography are therefore quickly realized, especially when there is a need for periodic updating of the entire data base.

Landsat Applications

The Division of State and Regional Planning within the Department of Community Affairs applied computer-mapping techniques using Landsat to 208 Water Quality Management Planning. During 1973 the Division provided land

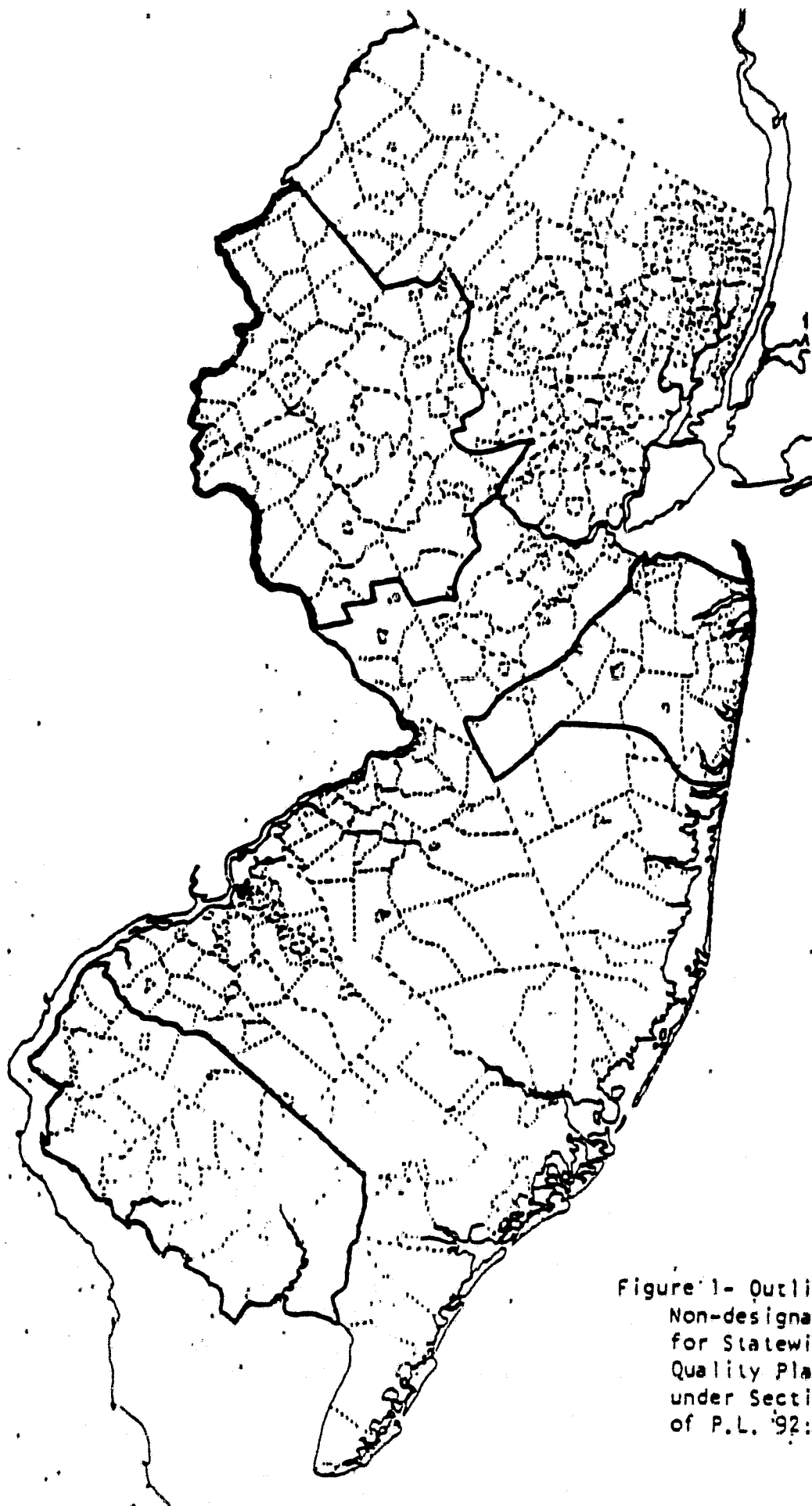
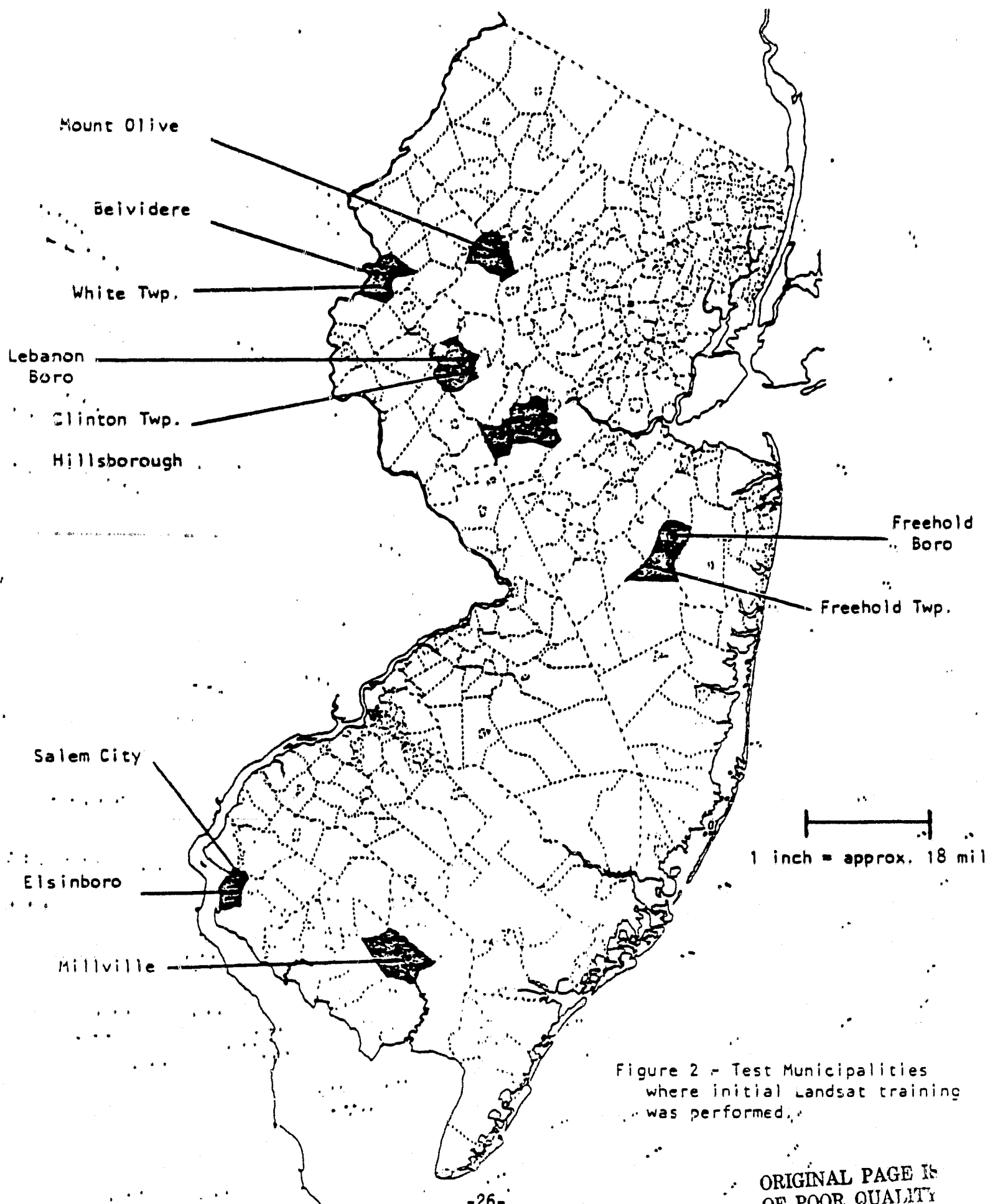


Figure 1- Outlines indicate
Non-designated Areas
for Statewide Water
Quality Planning
under Section 208
of P.L. 92: 500



cover maps and acreage statistics to the Division of Water Resources, Department of Environmental Protection, for approximately one-third of the state. This information served as an integral part of the data base needed for effective water quality management planning, since detailed analysis of land cover is important in the assessment of non-point source pollution loads on watersheds. The information derived from land cover inventories was combined with population and employment data for use in the Water Quality Management Plans.

Landsat multispectral data tapes were integrated with digitized maps of the state's watersheds and municipal boundaries to serve as the primary data base. This provided a comprehensive means of mapping Level 1 USGS land use/land cover (forest, wetlands, surface water, vacant/pasture, barren/extractive; suburban residential, urban/industrial/commercial) for individual watersheds or political jurisdictions in the study areas. In order to establish some measure of accuracy for the Landsat maps, sample areas containing significant geographic features were compared with aerial photographs and first-hand knowledge of the staff. The maps have shown a maximum of 15% misclassification, with most samples containing less than 10%. For the most part, only classification anomalies were field-checked, thereby reducing the cost of field work.

The 208 effort was considered to be an ideal opportunity to illustrate the effectiveness of using computer graphic techniques with remote sensing data for environmental planning and cost about \$3 per square mile.

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"DRAFT"

Texas

Summary of State Program

The Texas Department of Water Resources (TDWR) has primary authority in conducting programs under the federal act. The Railroad Commission of Texas (RRC) has jurisdiction in issuance of wastewater permits regulating discharges of wastes resulting from development and/or production of oil and gas. For 208, the designated and statewide (non-designated) planning areas are set out in figures 1 and 2, respectively.

Proposed activities for water quality management planning are based on the long-term planning strategy outlined in the state strategy document.¹ At the present time, the major activities proposed to be undertaken in fiscal year 1980 are as follows:

- (1) In areas where violations of stream standards occur because of discharge of point sources, intensive monitoring surveys will be conducted to provide data input for model development for waste-load evaluations.
- (2) Additional assessment of facility needs and recommendations for management agencies will be addressed in areas where changes in population or growth have occurred.
- (3) Technical and financial assistance will be provided to cities that require treatment programs but are not eligible for funding through the construction grants program.
- (4) Alternative advanced waste treatment strategies will be developed and assessed in areas summarized in Part II.
- (5) The potential impact of surface mining of lignite on surface water and ground water will be assessed by implementation of a monitoring program that will provide the data base for future evaluation of the appropriateness of existing control strategies.
- (6) The potential for degradation of water quality due to non-point sources will be evaluated by implementing sampling programs designed during fiscal year 1978 and fiscal year 1979.
- (7) In areas where impacts and sources of water quality problems have been previously identified, alternative control strategies and best management practices will be assessed. Applications for participation in cost-share programs will be developed for areas which are found to have demonstrated water quality problems due to agricultural/silvicultural activities.

1 State of Texas Water Quality and Waste Management Strategy, FY 1980.

FIGURE 1

DESIGNATED 208 PLANNING AREAS

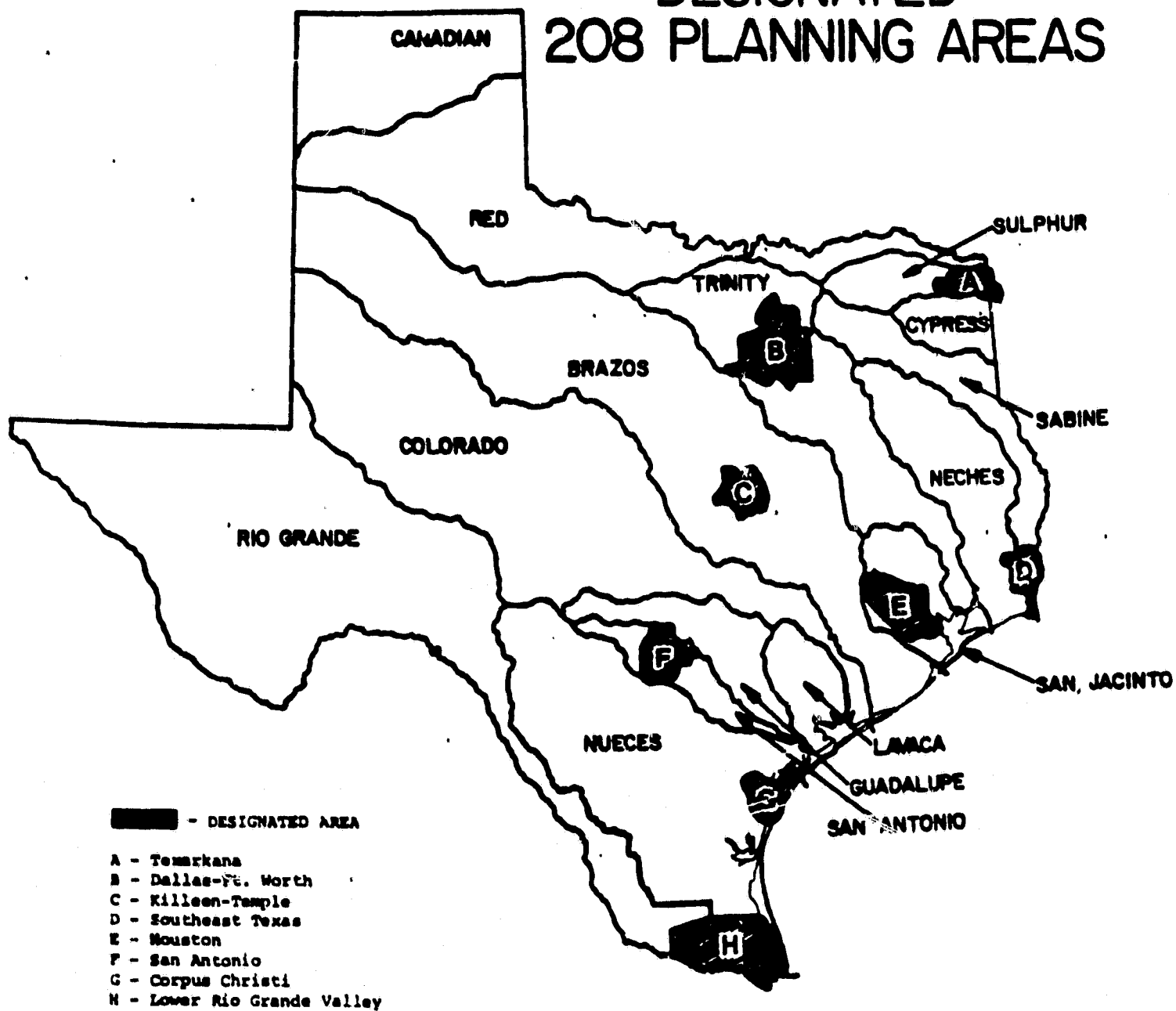
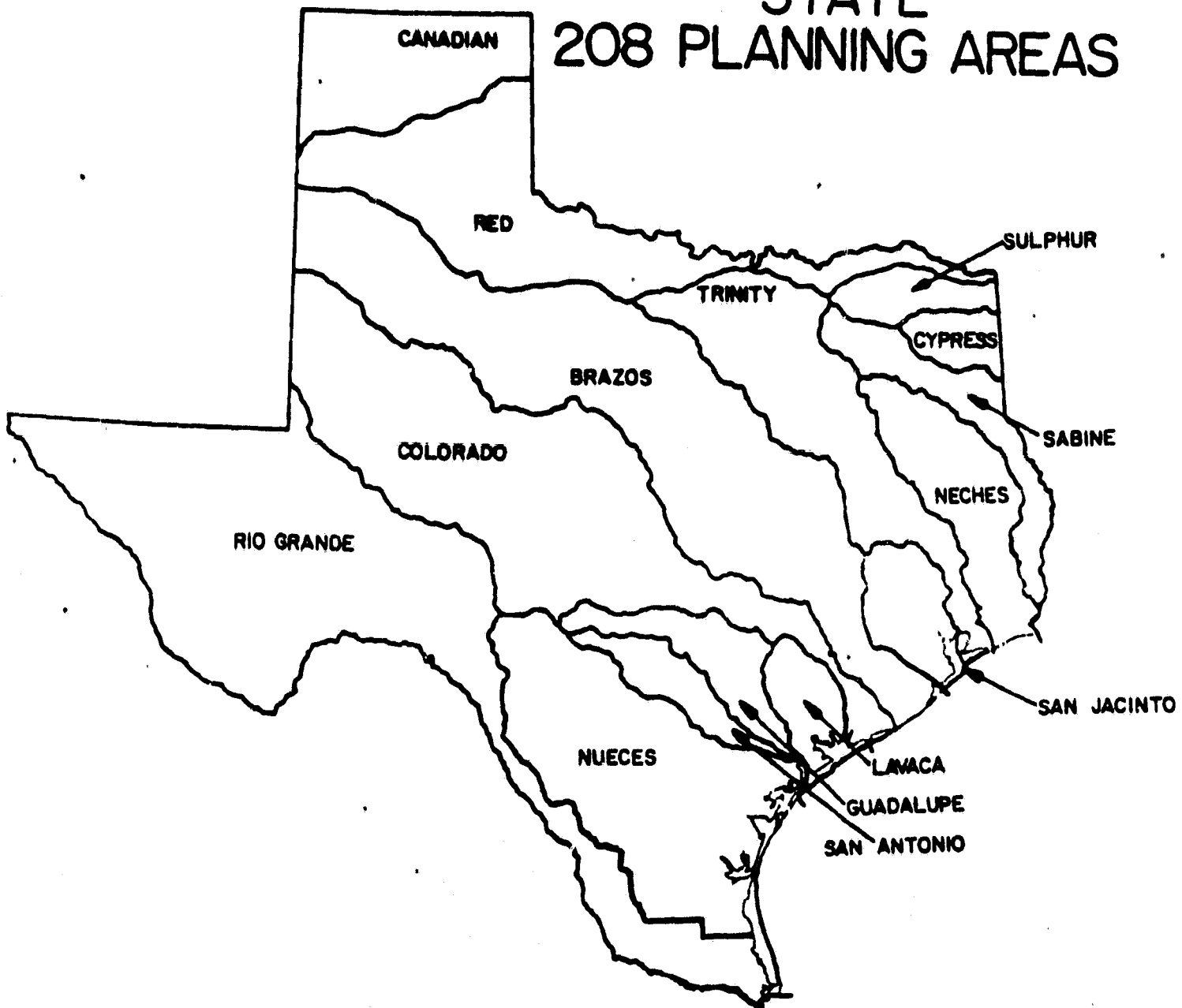


FIGURE 2

STATE 208 PLANNING AREAS



- (8) The potential for degradation of water quality in areas currently compliant with stream standards will be addressed through an assessment of facility needs and studies to determine the effectiveness of septic tanks. In several areas effort will be devoted to the development and assessment of alternative septic tank control strategies.
- (9) The impacts of potentially toxic pollutants on surface water will be addressed through implementation of intensive site-specific surveys in areas where potentially toxic substances have been found. In areas with potential toxic pollutant discharges, monitoring programs will be established to determine extent and levels. These data will be utilized to determine the need and appropriateness of stream standard for specific substances not presently included in the standards with numerical limits.

The TDWR will oversee non-point source planning activities which are of statewide significance. Locally significant water quality problems arising as a result of non-point sources will be documented and verified through contractual agreements with local planning agencies.

Agricultural/silvicultural non-point source problems will be addressed as appropriate through the Rural Clean Water Program established by Section 208(j) of the Clean Water Act. This program authorizes funding to assist in implementing best management practices.

It is anticipated that the first application for cost-share funds under the Rural Clean Water Program will be submitted in fiscal year 1980 if interim studies indicate that such actions are needed and feasible. These interim studies, which will have been undertaken in three areas prior to fiscal year 1980, will include an inventory of current practices, an assessment of suitable best management practices, and, in most cases, water quality sampling programs. The responsibility for this program rests with the TDWR, the Texas State Soil and Water Conservation Board, the Texas Forest Service, and local conservation districts. These agencies will coordinate the program with other interested agencies in accordance with State Executive Orders WPC-5 and DB-39.

Rationale for Use of Landsat

The first phase of 208 activities in Texas emphasized compilation of existing data, with one exception: Current land use/land cover information was not readily available statewide to assist non-point source planning studies.

Texas is a very large state, exceeding 270,000 square miles in area, with a wide variation in climate, physiography, and land use/land cover. On the Texas/Louisiana border, rainfall exceeds 40-50 inches annually and coincides with large areas of southern pine forest, but at El Paso, more than 800 miles westward on the border of Texas with New Mexico, desert conditions prevail with average annual rainfall only about 8 inches.

Landsat was chosen as a logical data source for a land use/land cover inventory because:

- (1) Current aerial photography was not available (the last complete coverage of Texas was during the mid-1950's) and
- (2) The cost of new aerial photo coverage was estimated to be at least \$1 million, whereas enlarged photos of 47 Landsat scenes - enough to cover Texas - would not exceed \$10,000.

Landsat Applications

The manual interpretation of level 1 categories for land use/land cover took about 1½ man-years, for a scale of 1:250,000. However, the resulting publication, Land Use/Land Cover Maps of Texas is in its second printing and has been well received by local planners.

The TDWR has since initiated a pilot project with the Texas Natural Resources Information System to produce computer-generated land cover maps and statistics of selected areas. Plans are contemplated to update this land use/land cover information at least every 5 years using the state capability for machine processing of Landsat data.

The TNRIS already supports 208 planning efforts by providing existing water and other data needed by state or local agencies (see attached TNRIS overview). In addition, TNRIS has under way several related joint projects involving Landsat: (1) to inventory lakes and empoundments; (2) to detect some water quality parameters in empoundments, such as turbidity and vegetation; and (3) to estimate runoff from urbanized areas and irrigated fields.

Existing capability in TNRIS to process Landsat tapes was developed primarily with the assistance of NASA. However, the use of Landsat is expanding dramatically in Texas, largely through the efforts of TNRIS acting as a technology transfer agent for state agencies.

It should also be stressed that, although TNRIS and other entities in the state government have recently given special emphasis to Landsat, it is considered to be only one tool among many in remote sensing. For many applications, conventional aerial photography, with its greater detail, will still be the best answer. Other problems will call for a combination of data types, including aerial photography, and both manual and computer analysis of Landsat data. Landsat will continue to complement, rather than replace, other remote sensing systems in Texas. Rather than overselling any single system, the goal of TNRIS is to be able to determine which system or combination is the most appropriate for the job at hand.

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TEXAS NATURAL RESOURCES INFORMATION SYSTEM OVERVIEW

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One of our State's greatest assets is its natural resources, and one of our great challenges is the proper planning, developing, managing, and conservation of these resources. Many agencies within the State are vitally concerned with one or more of the aspects of the State's natural resources. The need to consider the total effects of any particular action or project on the natural resources of the State, demonstrated by the public concern for preservation of environmental quality, has become abundantly evident. The resource manager, whether involved in regulatory and enforcement activities, managing a natural resource, or planning the future use of natural resources, needs to apply a multidisciplinary approach to his effort. This approach requires that a number of different types of natural resources and socioeconomic data and information be readily available to the resource manager. Federal legislation requiring the filing of environmental impact statements on a wide variety of projects, and other federal legislation concerning areas of environmental protection, resource management, and land use planning further point out the need for an integrated approach.

In the area of natural resources in Texas, interagency cooperation and data accessibility are encouraged through such coordinating bodies as the Interagency Council on Natural Resources and the Environment (ICNRE) and the Natural Resources Council (NRC). In September 1977, the NRC assumed responsibilities for natural resource-related activities previously coordinated through the ICNRE. Representation on such interagency coordination entities usually includes the administrative heads or other key leaders of Texas resource agencies, with ex-officio representation including several resource-related entities, under the chairmanship of the Governor of Texas or his representative.

In June 1972, the ICNRE approved a recommendation from its Water Oriented Data Programs Section (WODPS) to establish the Texas Natural Resources Information System (TNRIS), building upon the success of the Texas Water Oriented Data Bank, which dates well back into the 1960's. Initial TNRIS work included an inventory, conducted by a 14-member interagency task force, to identify and categorize textual, computer processable, mapped, and other types of natural resources data. The data were grouped into six major categories: Base Data, Biological, Meteorological, Geologic and Land, Water, and Socio-Economic. In the spring of 1973, the WODPS forwarded the documented inventory results and further recommendations for continued TNRIS development to the ICNRE, which approved the recommendations.

Subsequently, the ICNRE established the TNRIS Task Force, with representation from each of the member agencies, to pursue TNRIS implementation, with work beginning on two activities identified by the WODPS: (1) a detailed inventory of machine processable natural resources data of ICNRE agencies and (2) concurrent development of a TNRIS conceptual design plan. In September 1974, a valuable product of the detailed file inventory, "The TNRIS File Description Report," was published. It was revised in August 1977. In December 1974, a report entitled "TNRIS Conceptual Design," containing specific recommendations for continued TNRIS implementation, was published by the Task Force and presented to the ICNRE.

The ICNRE accepted the TNRIS Conceptual Design Report along with its associated recommendations, and in March 1975 the Council adopted a resolution endorsing additional TNRIS Systems Central staff. With Council support, and support from the State Budget Offices, legislative approval to fund additional TNRIS staff was received from the 64th Legislature and reaffirmed by the 65th Legislature.

Currently, in addition to inventories of and access to machine processable data, TNRIS inventories of non-machine processable data are being directed toward a variety of valuable TNRIS/TWODB requirements to determine the need for new or additional information files or capabilities. Among the most important of these are incorporation of microfilming, text processing, and map manipulation techniques into TNRIS/TWODB activities. Additional activities include the integration of remote sensing technology and data into TNRIS/TWODB efforts, development of geocoding and Geographic Base file handling systems, and enhancement of data analysis and presentation capabilities to include the latest in interactive graphics and visual presentation.

In addition to providing access to a wide variety of state-held data, TNRIS provides access to a number of automated natural resource data bases available from federal agencies and private entities. TNRIS access to federal systems includes interface with the USGS' National Water Data Exchange (NAWDEX), National Cartographic Information Center, and Computerized Resources Information Bank (CRIB) for energy information, the U.S. Department of Agriculture's Federal Assistance Programs Retrieval System (FAPRS), the U.S. Department of Interior's Computerized Water Resources Abstracts (WRA) file, and several files of computerized abstracts available through the System Development Corporation's ORBIT system. Additionally, interface is maintained with data systems of the National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), Environmental Protection Agency (EPA), the Census Bureau, and other entities. TNRIS access to these data systems significantly increases the natural resources data holdings available to the TNRIS user community.

Data requests come to TNRIS in many ways: by letter, telephone, walk-in, and via computer terminals. The data are provided to state, federal, local, and private entities in the form of printed reports, punched cards, computer tape, aerial photography, microform, and computer graphics output. The data files available and associated output formats are described in the TNRIS File Description Report. Detailed descriptions of capabilities associated with TNRIS data files are described in User's Reference Manuals.

As a part of direct TNRIS support of member agencies, a series of TNRIS "joint projects" has been initiated. These joint projects, formulated between the TNRIS and one or more participating agencies, are designed to support natural resources planning and management needs of the agencies. Additional TNRIS operational capabilities resulting from these projects are made available to all TNRIS users upon project completion. A series of Support Activities Reports is being published to document joint projects as they are completed. The TNRIS Education Program and the quarterly TNRIS Newsletter also serve to keep the user community abreast of current capabilities and services.

TNRIS, as earlier envisioned, is now facilitating the fulfillment of the specific statutory responsibilities and administrative needs of the various agencies involved in planning, developing, operating, managing, conserving, and protecting the natural resources of the State. The System is providing maximum availability of natural resources information, consistent with cost and efficiency, to state, federal, regional, local, and private entities to support a variety of activities including water resource planning, coastal zone management, land use planning, energy conservation efforts, and other resource endeavors. The System is serving as a cost-effective mechanism for linking together users of natural resource and related data with those agencies and institutions who collect and store the data.

TEXAS NATURAL RESOURCES INFORMATION SYSTEM TASK FORCE

Participating agencies: Texas Department of Water Resources • General Land Office • Texas Air Control Board • Texas Forest Service • Texas Industrial Commission • Texas Department of Health • Bureau of Economic Geology, University of Texas at Austin • Railroad Commission of Texas • Texas Department of Agriculture • State Department of Highways and Public Transportation • Texas Parks & Wildlife Department • Texas State Soil & Water Conservation Board • Texas Coastal and Marine Council

TOWARD MORE EFFECTIVE APPLICATIONS.

The experiences of the five states described in this report indicate a positive relationship between a federal grant program, such as EPA 208, and the use of innovative techniques from satellite remote sensing. These experiences also indicate the necessity of having an active technology transfer program tailored to state government needs.

Although the states were selected initially for previous involvement with NASA technology transfer efforts, there was no attempt made to insure that successful applications of Landsat would be found in the 208 program. Interestingly, all of the 208 program staff surveyed were knowledgeable of Landsat's potential and had made some use of Landsat-derived information as part of their non-point source planning activities. In addition, 208 users showed initiative in defining their information needs and selecting applications appropriate for the resolution and availability of Landsat data.

State agency staff responsible for water quality planning, however, did express a preference for acquiring Landsat support services from state capabilities rather than private industry. This preference was primarily because of a perception that state capabilities would be more responsive, more adaptable to their needs - and much easier to access.

Existing Landsat capabilities tend to be institutionalized within a state government information service where they can be more easily accessed by state agencies. For example, Landsat analysis is incorporated in South Dakota in the Land Resource Information System (LRIS) of the State Planning Bureau; and in Texas, Landsat data is acquired and can be computer processed through the Texas Natural Resources Information System (TNRIS).

State use of Landsat has been associated with the development of automated geographic information systems (AGIS). In some states, Landsat capabilities appeared to be a catalyst for AGIS development, while in others Landsat was merely an obvious addition primarily because the data was already available in a computer format. It is this capability development, the AGIS, in which state abilities to respond to demands for statewide comprehensive planning requirements will be dramatically increased. And Landsat data, as well as remote sensing data from future satellite systems, is anticipated to play an important and necessary role.

Although not always a visible data source, Landsat has provided tremendous cost savings in the cost of data alone, such as shown in the case study of Texas, and improved 208 program performance. And even more important, Landsat has opened doors for more creative applications, using the AGIS concept that could not be attempted in state budgets using conventional remote-sensing data because of cost and time constraints. For most states, Proposition 13 or similar budget constraints have greatly reduced the available funds to purchase data or increase staff. It seems important that federal grant programs such as the 208 program should continue to be sensitive and supportive of these developing capabilities in the states.

OBJECTIVE OF THE REPORT

Landsat-derived remote sensing data has present and potential utility for meeting national goals for water quality planning. Specifically, EPA "208" area-wide waste treatment management calls for identification and control of activities in large geographic areas requiring data attainable from remote sensing.

Intergovernmental, cooperative effort is necessary to achieve the goals established for areawide water quality planning and management by the Federal Water Pollution Control Act. The federal program officer oversees and assists the states and other non-federal agencies in meeting these goals, which are given clearer definition for action in regulations promulgated by EPA, and EPA "208" agency personnel collect necessary data and develop the plans leading to implementation.

Landsat remote sensing can be one tool in developing plans, guiding implementation and monitoring results. State experiences illuminate this potential for both the Federal Program Officer responsible for overseeing and the non-federal operating agency personnel responsible for planning and implementation.

This report provides both the framework for EPA "208" areawide planning - federal legislation and regulations - and examples of state opportunities and experiences using Landsat. Present activities suggest that this type of remote sensing is an efficient, effective tool for areawide water quality planning. New capabilities are being developed. Interaction with cognizant federal, state and local people involved in 208 activities can guide these developments and enhance their utility and prospect for use.